Chart lacking

SUMMARY OF PUMP IRRIGATION LOAD

BY MEMBERS OF THE

TRI-STATE GENERATION AND TRANSMISSION ASSOCIATION, INC.

COLORADO 47 TRI-STATE

JANUARY 1955

Electric Operations and Loans Division
Rural Electrification Administration
U. S. Department of Agriculture
Washington 25, D. C.

Electric Operations and Loans Division
Rural Electrification Administration

Colorado 47 Tri-State
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Summary of Pump Irrigation Load
By Members of The
Tri-State Generation and Transmission Association, Inc.

Pump irrigation installations served by members of the Tri-State Generaation and Transmission Association makes up an important part of the power load to be served by the association. It is also anticipated that the number of irrigation installations requesting electric service will continue to increase. It is an accepted fact that pump irrigation is a major factor essential to the agricultural economy of the area. Due to the arid conditions and without irrigation, agriculture production is not possible in much of the area served by members of the associations. Considering these conditions, it is essential that information on those factors which could affect the irrigation load, be analyzed and data made available for sound processing of loan applications received from this borrower.

The contents of this report does not purport to establish the economic feasibility of serving the irrigation loads included in this report nor does it intend to imply that funds are or will be earmarked by the Rural Electrification Administration for service to such loads. This report summarizes conditions individually on those members' systems in which the pump irrigation load constitutes an important part of their total load. It may be deemed advisable to investigate the irrigation load on other member systems should it develop as a major load.

Since time and available personnel did not permit a more detailed survey to be made, the summary presented herewith represents the judgment determined through experience and by the evaluation of data available on the factors affecting the development of pump irrigation in each member's area. It is not intended that this report be considered as a complete and comprehensive Electric Pump Irrigation Survey report as is usually conducted upon irrigation borrower's systems. A more comprehensive study may be desirable on some of the areas included in this report.

IRRIGATION SUMMARY
MORGAN COUNTY RURAL ELECTRIC ASSOCIATION
COLORADO 15 MORGAN

General

The area served by this borrower is one of the most highly concentrated and productive irrigation areas in Colorado. Agricultural production is highly diversified with numerous types of crops produced. Irrigation farming is carried out primarily in the river and creek valleys. Livestock raising and feeding is an important part of their agricultural production and contributes to the irrigation farming. In general, the agricultural economy of the area which directly affects the economy of the electric cooperative, is directly tied to irrigation.

Irrigation Development

Originally, irrigation water was supplied to the farms of this area through a series of canals and ditches with water diverted primarily from the South Platte River. The flow of other small tributaries to the platte were utilized for irrigation purposes wherever possible. With a greater demand being made upon the available surface water supplies, plus those years when low precipitation resulted in low river flows, the available water was often inadequate to meet requirements. As information became available as to the extent and availability of ground water in the valleys adjacent to the South Platte and its tributaries, wells were drilled into these aquifers and pumps installed to secure added irrigation water. The number of wells and pump irrigation installations have continued to increase in number.

Power for Irrigation Installations

First pump installations were supplied power through the use of internal combustion engines. These were of the automotive and industrial type originally using gasoline in which the majority eventually converted to butane. Some diesel power units have and are being used. With the development of the Morgan County Electric Cooperative and as electric power became more available, the majority of the irrigation installations converted to electric power. During the 1954 irrigation season the borrower had connected 1066 pump irrigation motors which totaled a measured load of 28,911 horsepower. During the 1953 season, 66.5 percent of the borrower's total kwh sold was to irrigation installation (25,929,989 kwh) and 54.1 percent of their total revenue ($380,656) was from irrigation installations.

Sources of Groundwater

Wells have been drilled and pump irrigation installations developed in the following areas:

South Platte River Valley
Comanche or Kiowa Drainage Valley
Bijou Drainage Valley
Beaver Creek Valley
Prospect Valley

The largest and most dependable are the developments along the South Platte River. The wells located in this area have available the most stable ground water supply. This is due to the large recharge to the underground reservoirs from, (a) drainage area of the South Platte River to the west, which extends into the higher rocky mountains and, (b) the percolation of water into the ground water reservoir from surface water supplied to the land through irrigation ditches and precipitation. During the past few years due to drought conditions, a lowering in water table has been observed. It is anticipated that during periods of normal or above normal precipitation years, the ground water table will be recharged to its normal level.

The irrigation pump load in this valley has developed on a sound basis. Added development and new installations can be anticipated. However, it must be realized that during periods when precipitation and river runoff is normal or above, less pumping will be required and less revenue will be received by the borrower from the pump installations served.

Ground water conditions in the other valleys are not as favorable. Areas of recharge are much smaller and little surface water is available for irrigation. Based on information from personnel of the U.S.G.S. Ground Water Branch located at Federal Center, Denver, Colorado, they feel that there has been an overdevelopment in wells and pump installations in these valleys. Present development has resulted in a continuous lowering of the static water table. Many of the wells have been drilled through the saturated material and during the past season had exhausted the available water. Practically all wells have a reduced discharge. Farmers are drilling new wells to increase their individual supplies but for these valleys as a whole, it is a matter of "Robbing Peter to Pay Paul."

Too much additional development cannot be expected in these areas. It may result that a reduction in the number of installations will occur, plus a sizeable reduction of use and revenue from other installations. The borrower should exercise caution in extending service to additional pump installations in these areas. It may be desirable that a more comprehensive survey be made in these areas.

Summary of Service To Irrigation Installation

Following is a summary of the growth and results of service to irrigation installations:

Year	No. Installations	Total HP	Total KWH Sold To Irrigation	Revenue From Irrigation Installations	Avge. HP/ Installation	Avge. KWH/ HP	Revenue Per HP	Avge. KWH/Installation
1946	439	10,854	10,448,723	$ 191,470	24.72	963	17.64	23,801
1947	495	12,691	9,394,858	186,826	25.60	740	14.72	18,979
1948	567	14,827	14,451,514	551,187	26.15	974	16.94	25,487
1949	553	14,461	11,517,060	218,354	26.15	796	15.10	20,826
1950	633	18,182	19,718,556	321,307	28.72	1,085	17.67	31,151
1951	746	20,977	18,696,571	326,538	28.12	891	15.57	25,062
1952	827	*(23,156)	28,028,505	-	*(28.00)	1,210	-	33,891
1953	922	*(25,816)	25,929,989	380,656	*(28.00)	1,004	14.75	28,123
1954	1066	28,911	40,627,033	545,280	27.27	1,405	18.86	38,111

*Estimated

Estimates of Future Development

The following are estimates of future development:

	Present 1954	Two Years	Five Years	Ten Years
Number Installations	1,066	1,300	1,450	1,600
Avge. HP/Installation		28	28	28
Avge. An. kwh/HP		1,000	1,000	1,000

IRRIGATION SUMMARY
UNION RURAL ELECTRIC ASSOCIATION, INC.
COLORADO 22 BOULDER

General

The area served by this borrower is similar to that of Colorado 15 Morgan. Farming is highly diversified with numerous crops produced. Farm units may be smaller in that area which is close to Denver with a greater subdivision of land holdings. The agricultural economy of the area served by this borrower is directly dependent upon irrigation farming.

Irrigation Development

Irrigation in the service area of this borrower was originally developed through diverting the surface waters from streams fed from the mountains to the west. The largest source of irrigation water was from the South Platte River. The demand on these waters have been so great that over the years, shortages have progressively increased. Not only has the demand for water for irrigation increased, but the added requirement and needs to supply water to the rapidly growing metropolitan area of Denver has affected the available surface water supply for irrigation. The most serious conditions of shortages occur during periods of drought as has been the case during the past few years.

To offset these water shortages, numerous wells have been drilled and irrigation pumps installed. In some cases, water rights have been purchased outright from the farmers by the City of Denver, to bolster their supply. To offset this they have drilled wells for their irrigation supply. Due to these factors the number of irrigation installations have steadily increased in the various stream valleys of the area served by this borrower.

Power for Irrigation Installation

As in the area served by Colorado 15 Morgan, pump irrigation was developed by using internal combustion power units. As electricity became more available, conversions were made to electric power. At the present time this borrower is providing service to 324 pump installations totaling (based on name plate readings) 4,682 horsepower. During the 1953 season, 22.0 percent of the borrowers' total kwh sold, was to irrigation installations, and 18.0 percent of their total revenue was from irrigation installations.

In the same general area, the Public Service Company of Colorado is also providing electric service to a large number of irrigation installations.

Sources of Ground Water

Wells have been drilled and pump irrigation installations developed in the following areas:

South Platte River Valley
Saint Vrain
Hudson-Barr Lake Area
Box Elder Creek

Conditions in the South Platte River Valley are the same as are found in the area served by Colorado 15 Morgan. Also similar is the pump irrigation development in the Saint Vrain area only on a much smaller scale. In these areas added development and new installations can be anticipated. Also additional units presently powered by internal corbustion will convert to electricity.

Based on data from U.S.G.S., the drainage areas and recharge into the Hudson-Barr Lake Area and Box Elder Creek Area are not so favorable. They feel that these two areas have been developed to maximum safe limits.

Under some conditions over-development has taken place. The borrower should exercise caution in extending service to additional installations in these two areas. It may be desirable that a more comprehensive survey be made in these areas.

Summary of Service To Irrigation Installation

The following is a summary of the growth and results of service to irrigation installations:

Year	Number	Total KWH	Avge. Annual KWH
1945	83	307,555	3,705
1946	138	461,083	3,341
1947	133	487,200	3,663
1948	161	815,971	5,068
1949	161	718,625	4,463
1950	202	1,748,867	8,658
1951	205	1,426,524	6,959
1952	236	2,060,100	8,730
1953	249	2,629,546	10,560
1954	324	3,933,801 (Thru Oct.)	
1954 (est. for entire Year)		4,000,000	12,345
1945-54 average			7,740

Estimates of Future Development

The following are estimates of future development:

	Present	Two Years	Five Years	Ten Years
Number Installations	324	420	480	530
Avge. HP/Installation	14.45	15	15	15
Avge. An. kwh/HP		600	600	600

IRRIGATION SUMMARY
HIGHLINE ELECTRIC ASSOCIATION
COLORADO 29 PHILLIPS

General

The area served by this borrower is primarily a dry land wheat farming area. Although some irrigation is carried out in the borrower's area, the agricultural economy is primarily dependent upon the dry land wheat farming.

Irrigation Development

The larger irrigation areas served by this borrower are similar to that described in Colorado 15 and 22. Irrigation was primarily started by diversion of surface water, and as the demand for water became greater, wells were drilled into the underground reservoirs to supplement the surface water. These areas include the development along the South Platte River and that in the Lodge Pole Creek Area.

Additional development of irrigation installations is taking place east and south of Holyoke in an area known as the Frenchman Creek. The development here is new and is in the center of the dry land wheat farming area. The recent drought conditions have probably been a stimulating factor in the development of irrigation wells in this area. Irrigation has been primarily for feed crop and the results of added production has developed considerable interest to the farmers in this area.

Sources of Ground Water

The description given of pump irrigation development in the South Platte River Valley are the same in this borrower's area as has been described previously in this report. A large portion of these installations are served from the borrower's Sterling substation. There is

one additional valley considered as a part of this area. It is known as the Pawnee Creek Area which enters the South Platte River in the vicinity of Sterling, Colorado. The drainage area of this creek is smaller but it is felt that the available underground water supply of this source is adequate for present and some additional development.

The other portion of the South Platte River Valley is served by their Julesburg substation. This area extends along the Platte Valley from approximately 6 miles west of Sedgwick to Julesburg. This substation also serves the irrigation development from Chappel, Nebraska along the Lodgepole Creek to where it enters the South Platte River. The Lodgepole Creek orignates in the Medicine Base National Forest Area between Cheyenne, and Laramie, Wyoming. From there it runs eastward until it enters the South Platte River.

In addition to the irrigation installations served by this borrower in the Lodge Pole Creek Valley, other units are served by Nebraska 95 Cheyenne and Wyoming 14 Laramie.

The valley as a whole is underlain with stratas of sands and gravel overlaying a strata of silty clay. The source of water is from the sand and gravel formation. The wells served by this borrower are of relatively large capacity with low lifts. Average pumping levels are between 20 and 25 feet, with discharges averaging approximately 900 gallons per minute. Water pumped from these lifts are considered very economical. The history and experience based on existing wells has shown that the ground water supply has remained very stable. It appears that the existing wells, plus additional installations could be supported by this ground water aquifer. Pump irrigation has proven itself as economically sound in this valley and favorable consideration can be given to providing service to these installations.

The Frenchman Creek area which includes a large portion of the area served by this borrower east of Holyoke is favorable to development of irrigation wells. The underground structure consists of stratas of sandstones and sand and gravel formations. Many of these stratas are saturated and will yield relatively large quantities of water to wells. Pumping lifts in many areas will be less than 50 feet. It has been estimated by the U.S.G.S. that in the Frenchman Creek Ground Water Reservoir there are 150,000,000 acre feet of water in storage.

Development is relatively new and at the present time the borrower is providing service to 17 installations. There are approximately 70 wells drilled and operating in the borrower's area, but due to their scattered condition, it is not feasible for the borrower to extend service. Additional new installations are anticipated and many of these installations, where feasible, will be served by the borrower.

Based on U.S.G.S. data, there is no question as to the capabilities of this aquifer to support a large number of irrigation installations. It is considered by the U.S.G.S. as one of the greatest undeveloped grounded water areas in the west.

Summary of Service to Irrigation by Substation

The following is a summary of the growth and results of service to irrigation installations for the past 5 years:

	1950	1951	1952	1953	*1954
Holyoke & Lamar Substations					
Number of wells	5	7	9	12	17
Total KWH	104,630	50,769	201,010	255,519	432,270
Total Metered HP	95	154	251	372	536
Average KWH	20,900	7,240	22,350	21,300	25,400
Average Metered HP	19.0	22.0	27.9	31.0	31.5
Julesburg Substation					
Number of Wells	22	25	28	43	63
Total KWH	114,458	76,688	166,489	213,431	687,166
Total Metered HP	351	411	458	626	1,001
Average KWH	5,200	3,060	5,950	4,960	10,900
Average Metered HP	16.0	16.4	16.4	14.6	15.9
Sterling Substation Area					
Number of wells	20	22	25	32	43
Total KWH	227,548	194,355	303,615	323,894	700,130
Total Metered HP	390	408	434	570	870
Average KWH	11,400	8,900	12,170	10,100	16,300
Average Metered HP	20.2	17.8	17.4	17.8	20.2
Totals					
Number of Wells	47	54	62	87	123
Total KWH	446,630	321,812	671,114	792,844	1,819,566
Total Metered HP	836	973	1,143	1,568	2,407
Average KWH	9,500	5,960	10,800	9,100	14,800
Average Metered HP	17.8	18.0	18.4	18.0	19.6

*1954 Irrigation Season not complete.

Estimates of Future Development

The following are estimates of future development by substation and an estimate of future power requirements:

	No.	Avge. HP	Total HP	Avge. Annual KWH	Total KWH	KWH/HP
Present						
Holyoke and Lamar	17	31.5	536	25,400	432,270	805
Julesburg	63	15.9	1,001	10,900	687,166	687
Sterling	43	20.2	870	16,300	700,130	805
Total	123		2,407		1,819,566	
Two Years						
Holyoke and Lamar	27	20	810	24,000	648,000	800
Julesburg	83	15	1,245	7,500	622,500	500
Sterling	63	20	1,260	14,000	882,000	700
Total	173		3,315		2,152,500	
Five Years						
Holyoke and Lamar	50	30	1,500	24,000	1,200,000	800
Julesburg	100	15	1,500	7,500	750,000	500
Sterling	75	20	1,500	14,000	1,050,000	700
Total	225		4,500		3,000,000	
Ten Years						
Holyoke and Lamar	75	30	2,250	24,000	1,800,000	800
Julesburg	125	15	1,875	7,500	937,500	500
Sterling	100	20	2,000	14,000	1,400,000	700
Total	300		6,125		4,137,500	

Estimates for System Total

	Two Years	Five Years	Ten Years
Number installations	175	225	300
Avge. HP/Installation	20	20	20
Avge. An. KWH/HP	650	665	675

IRRIGATION SUMMARY
MOUNTAIN VIEW ELECTRIC ASSOCIATION, INC.
COLORADO 37 DOUGLAS

General

The area served by this borrower is very large, covering a portion of the east central part of Colorado. Dry land wheat farming, and livestock are the chief agricultural production. Except for an area close to Colorado Springs, irrigation is relatively new in the area. This area has been seriously affected by the recent droughts of the southwest, which has greatly increased the interest in pump irrigation.

Irrigation Development

Pump irrigation has been practiced for many years in the Fountain Creek Valley, Southeast of Colorado Springs. It has been used in conjunction with surface waters diverted for irrigation. As shortages of surface water developed, additional wells have been drilled.

Irrigation is new throughout most of the other areas served. With the recent drought conditions, farmers are drilling wells to locate water for irrigation purposes. During the 1954 season, the borrower had connected 164 pump installations with a total horsepower of 1,858. During the 1953 season, the borrower served 144 installations which consumed a total of 1,649,303 kilowatt hours. This represents 13.9 percent of the total energy sold by the borrower. Eight and two-tenths percent (8.2%) of the borrower's revenue came from service to irrigation installation.

Sources of Ground Water

Wells have been drilled and ground water resources developed in large enough capacities for irrigation in the following areas or valleys:

Fountain Creek Valley
Bee Ju Creek
Ellicott Area
Area Northeast of Limon
Big Sandy Creek
Kutch Area (So. of Simla)

Underground waters have been utilized in the Fountain Creek area for many years. Ground water levels based upon U.S.G.S. data have remained constant. They feel that if the groundwater reservoir is developed right it will be capable of supporting a large number of

additional wells. Development in other areas is new and little information is available as to the capabilities of the underground reservoir. It is felt that the underground reservoirs will support additional wells in the Ellicott area, the Bee Ju area and the area northeast of Limon. As for the other areas, no definite information is available but it is felt that additional development is possible in the Big Sandy Creek and Kutch area south of Simla.

As these areas develop additional irrigation studies should be made. As added development takes place, larger pump units will be required. Average hours of pumping will also increase in that a larger portion of the irrigation water supply will come from pumped wells. This is especially the case in the Fountain Creek area.

Summary of Service to Irrigation Installations

The following is a summary of service to irrigation installations:

Year	No. of Installations	Avge. HP	Total KWH Used	Avge. KWH/ Installation
1950	89	13.4	737,547	8,284
1951	113	12.2	847,407	7,500
1952	131	11.7	1,131,344	8,636
1953	144	12.1	1,649,303	11,453
1954	164	11.3	*1,805,948	*11,011

*Ten months - Jan. - Oct. inc. 1954

Estimate of Future Development and Power Requirements

The following are estimates of growth of service to irrigation installations and estimates of power requirements:

	Present	Two Years	Five Years	Ten Years
Number	164	200	250	300
Avge. HP/Installation	11.5	15	15	15
Avge. An. KWH/HP		1,000	1,000	1,000

IRRIGATION SUMMARY
POUDRE VALLEY RURAL ELECTRIC ASSOCIATION, INC.
COLORADO 31 LARIMER

General

The area served by this borrower is primarily a highly diversified irrigation farming area. It is located in the vicinity of Fort Collins with most of the irrigation on level land adjacent to the high Rocky Mountains and in the many small valleys which extend out from these mountains. The agricultural economy of this area is based almost entirely upon irrigation farming.

Irrigation Development

The area has several rivers and creeks which pass through it. They are tributaries to the South Platte River. These rivers and creeks originate in the higher mountains to the west and have provided the supply of water for irrigation. As in most areas where the demand for water became greater and shortages occurred, the underground sources, where available were developed. With relatively large sources of underground water available in this area, wells have been drilled and pumps installed. The growth in number of pump irrigation installations has been continuous.

Power for Irrigation Installations

Various type power units were used in the development of pump irrigation. As electricity has become available in more areas by various power suppliers, the majority of the pumps in the area have been converted to electric motors. During the 1954 season the borrower had connected 275 pump motors with a total horsepower, based on name plate readings of 3,822 horsepower. During the 1953 season the borrower served 204 installations which consumed a total of 1,671,315 kilowatt hours. This represents 12 percent of the total energy sold by the borrower; 10.5 percent of the borrower's total revenue came from these irrigation installations.

Sources of Ground Water

The ground water sources where water is available at reasonable pumping lifts are numerous but spotty throughout the area served. The main sources are in the valleys of the following:

LaPoudre River
Big Thompson Creek
Little Thompson Creek
St. Vrain Creek
No. Box Elder Creek

Established wells drilled into the underground reservoirs of these valleys provide a stable and dependable source of water. Present development has shown no adverse affects as to available supply. This is probably due to (a) the large drainage and favorable recharge areas, (b) the high precipitation in the higher mountains which make up their drainage areas and, (c) the percolation of water into the ground water reservoir from surface water applied to the land for through irrigation ditches. Additional development can be anticipated with additional irrigation units being served by the borrower. Service to irrigation motors in this borrower's areas can be based on a sound continuous irrigation load.

Summary of Service to Irrigation Load

The following is a summary of the increase in service to irrigation installation and their annual kwh usage:

Year	No. of Installations	Total KWH Used	Avge. KWH/ Installation
1945	43	94,279	2,192
1946	53	269,212	5,080
1947	73	257,309	3,525
1948	89	691,739	7,772
1949	97	536,917	5,535
1950	133	1,045,015	7,857
1951	160	937,716	5,860
1952	192	1,306,261	6,803
1953	204	1,691,315	8,290
1954	275	3,701,085	13,458
10-year average annual consumption per installation			7,984

Estimate of Future Development and Power Requirements

The following are estimates of growth of service to irrigation installations and estimates of power requirements:

	Present	Two Years	Five Years	Ten Years
Number	275	350	400	450
Avge. HP/Installation	13.9	15	16	17
Avge. KWH/HP		580	580	580

IRRIGATION SUMMARY
Y-W ELECTRIC ASSOCIATION, INC.
COLORADO 38 YUMA

General

This borrower serves an area in east central Colorado. Dry land wheat farming and livestock are the principal agricultural production. The borrower is a relatively new one in that service started in 1948.

Irrigation Development

First irrigation installation was served in 1951. Since 1951, drought conditions have prevailed in this area which has increased the interest and number of irrigators receiving electric service. During the 1954 season, 70 irrigation installations were being served. These installations consumed a total of 1,414,529 kilowatt hours of electricity, which represents 13.3 percent of the total energy sold by the borrower. Revenue from irrigation totaled $26,386 which was 64 percent of the borrower's total revenue for 1954.

Much of the area where irrigation is carried out has a sandy soil condition, so both flood type and sprinkler irrigation has been developed in the area. Crops irrigated are primarily alfalfa, corn, potatoes, pinto beans, and pasture land.

Sources of Ground Water

The majority of the irrigation installations served by this borrower and where the greatest growth is anticipated, lies in the valley formed by the Arickaree River and the South Fork of the Republic River.

Where present development is small, and where it has made no affect upon the water sources, it appears that additional irrigation installations could be adequately supplied by the underground reservoirs of these valleys. Along the Arickaree River Valley, ground water is most shallow in the vicinity of Cope, Colorado and generally increases in depth toward the east. Most of the present development is in the Cope area and is served by the Arickaree substation. Water in this area stands between 20-60 feet. The area to the east is served by Joe's substation where the water table is approximately 100 feet. The area along the Arickaree served by the Idalia substation, the ground water level is between 100 and 200 feet. The static water level in the So. Republican River Valley is approximately 60 feet below the surface of the ground.

It is in the areas where the existing water table is less than 150 feet that the largest development can be anticipated. Some additional development is also anticipated along the north fork of the Republican River in the vicinity of Wray.

In each of the above areas as wells are developed and proven, they can be considered as sound, dependable irrigation loads. Present development has not shown any affect upon the available ground water supplies.

Estimates of Future Development and Power Requirements by Substation

Substation	No. Irrigation	Avge. HP	Total HP	Avge. An. KWH	Total KWH	Avge. KWH/HP
Present						
Arickaree (Cope)	38	16.17	614	19,143	727,430	
Joe's	13	42.08	547	32,377	420,900	
Idalia	12	18.03	216	17,789	213,466	
Wray	5	21.14	106	5,898	29,490	
Akron	2	10.44	21	6,195	12,390	
Total	70		1,504		1,403,676	
Average		22				933
Two Years						
Arickaree	45	16	720	20,000	900,000	
Joe's	20	42	840	42,000	840,000	
Idalia	22	25	550	25,000	550,000	
Wray	10	20	200	20,000	200,000	
Akron	2	10	20	6,000	12,000	
Total	99		2,330		2,502,000	
Average		24				1,000
Five Years						
Arickaree	55	16	880	20,000	1,100,000	
Joe's	35	42	1,470	42,000	1,470,000	
Idalia	35	25	875	25,000	875,000	
Wray	20	20	400	20,000	400,000	
Akron	2	10	20	6,000	12,000	
Total	147		3,645		3,857,000	
Average		25				1,000
Ten Years						
Arickaree	70	16	1,120	20,000	1,400,000	
Joe's	50	42	2,100	42,000	2,100,000	
Idalia	50	25	1,250	25,000	1,250,000	
Wray	35	20	700	20,000	700,000	
Akron	2	10	20	6,000	12,000	
Total	207		5,190		5,462,000	
Average		25				1,000

IRRIGATION SUMMARY
WHEAT BELT ELECTRIC MEMBERSHIP ASSOCIATION
NEBRASKA 95 CHEYENNE

General

Electric pump irrigation on this borrower's system will be carried out in three individual areas. These areas are designated as follows:

A. Pumpkin Creek Valley - That portion from the vicinity of Redington east to the North Platte River.

B. Lodge Pole Creek Valley - From an area two miles west of Sidney, Nebraska to the vicinity of Lodge Pole, Nebraska.

C. North Platte Valley - In the vicinity of Oshkosh and Broadwater.

Pumpkin Creek

Rephasing is currently being carried out to provide electric service to pump installations located in this valley. The majority of the installations presently to be served have been in operation for several years. New wells are currently being drilled. Approximately 15 installations will convert or adapt their pump installations to electric power immediately. It is estimated that a total of 30 installations will be served within the next five years and 45 units within the next ten years. With this development plus the existing and potential pump installations (approximately 100) to be served by the Wyrulec Company of Lingle, Wyoming, in the same valley, it may be that the maximum safe development is being reached as to available water supply. Prior to making funds available to serve pump installations in addition to the above estimated 145 units, the valley should be resurveyed and analyzed to determine effects of current development and soundness of additional development.

The Pumpkin Creek Valley is about 8 miles wide and starts near the Wyoming-Nebraska line. It runs from there 50 miles east to its confluence with the North Platte River. The main tributaries that enter Pumpkin Creek are from the South where there are springs in the Canyons that are cut into the adjacent table land or higher plains. The water from these springs flows on the surface only a few hundred feet and disappears into the alluvial mantle which covers the valley floor. Other numerous small creeks which carry water during periods of heavy rainfall contribute

to the underground water supply. It is in the alluvial formations where the majority of the irrigation wells are located. These wells are fairly close to the creek or valley floor where pumping lifts are most favorable. Other wells have been developed in other type formations but the majority and better wells for irrigation will be those in the alluvial fill.

Crops are primarily wheat, oats, hay, and corn. Other crops can be produced. The length of the growing season is 5 months which also represents length of pumping season.

The depth to the water table in Pumpkin Creek, in general, increases with the distance from the creek and in some places is more than 100 feet below the land surface. In the valley or lower areas where most of the irrigation is practiced, the water in most places is less than 25 feet below the land surface. From the wells being used for irrigation the yields range from 200 gallons per minute to 2,400 gallons per minute. Average installations are capable of approximately 1,000 gallons per minute. Installations will average approximately 30 horsepower and kilowatt hour consumption will approximate 600 kwh per horsepower. Wells in operation during the past have pumped annually approximately 100 acre feet of water.

Based on studies conducted by the Geological Survey, it is estimated that an average of about 21,000 acre feet of ground water leaves the Pumpkin Creek Valley annually. The following is an excerpt from Geological Survey Circular 156 entitled "Reconnaissance of the Geology and Ground-Water Resources of the Pumpkin Creek Area, Morrill and Banner Counties, Nebraska":

> It is estimated that an average of about 21,000 acre feet of ground water leaves the valley of Pumpkin Creek annually as surface flow. (See Table 1.) This represents the amount of rejected or excess ground water and is approximately the amount of additional ground water available for development. If sufficient ground water is withdrawn to cause a decline of the water table, additional water would be salvaged from loss by evaporation and transpiration and would be available for irrigation use. Also, some of the water pumped for irrigation would percolate into the ground-water reservoir. Part of this "return flow" could be reused; however, part of this water should be allowed to leave the area in order to prevent accumulation of salts in the soil and ground water.

Based on existing annual discharges of 100 acre feet per installation, the above estimates indicate that over 210 irrigation installations could be developed throughout the whole of the Pumpkin Creek Valley. Actual measurement of ground water level in wells in operation in the valley since 1934 shows no decline in water table with current development.

Recommendations

From data available and experiences of present development of pump irrigation farms in this area, I feel that financing of electrical dist. facilities to provide service to these irrigation installations could be based on a continuous and dependable pump irrigation load.

Lodgepole Creek Valley

Pump irrigation installations located in the Lodgepole Creek Valley have been served for several years by this borrower. At present 30 installations are being served in the Lodgepole Creek Valley.

This valley is underlain with stratas of sands and gravel overlaying a strata of silty clay. The source of water is from the sand and gravel formations. Depth to water varies considerably throughout the valley with water within 10 to 15 feet in some areas of the valley floor. Pumping lifts will average approximately 70 feet with pump discharges averaging between 600 and 700 gallons per minute. Difficulty has been experienced in some areas of the valley in getting wells with adequate discharges for irrigation.

History and experience based on existing wells has shown that the water supply has remained very stable. It appears that additional development of irrigation wells on a sound dependable basis is possible in this valley.

New connections for irrigation in this valley will average approximately 3 per year for the next 10 years or a total of 60 installations in 10 years. This includes sprinkler irrigation installations. Motors on pump installations will average approximately 20 horsepower and kilowatt hour consumption should average approximately 750 kwh per horsepower.

Field crops being irrigated consist of alfalfa, pasture, small grain and corn for silage. Row or cash crops consist of potatoes, pinto beans, and sugar beets. Considerable diversification of farming is possible in the area which contributes to successful irrigation farming. Good yields are being obtained and pump irrigation has proven economically sound in this valley.

It is recommended that full consideration be given to providing loan funds for service to irrigation installations in this valley which are included on loan applications received from this borrower. Should development exceed the above total of 60 installations then the valley should be resurveyed and analyzed to determine effects of current development and soundness of additional development.

North Platte Valley

The majority of the farms and land suitable for irrigation in the North Platte Valley are receiving irrigation water from diversion ditches. During some periods, due to poor ditch maintenance and dry years, some shortages of water have occurred. To offset this condition, several of the farmers most seriously affected have drilled wells which are used to supplement their ditch irrigation. There are a few farms which must depend totally on pumped water for irrigation and are presently using internal combustion units on their pumps. There is still acreage of land which is suitable to irrigation and could be developed.

The North Platte River Valley has available one of the largest and most dependable underground water sources. Numerous wells are located in this river valley from Wyoming to eastern Nebraska. Once a well is drilled and developed in this valley in the area served by this borrower it will always be a dependable and continuous source of water.

The question of financing and providing service to irrigation installations in this area is not one of available water or producing land but is dependent upon whether sufficient number of farmers are interested in drilling wells for irrigation and converting existing units to electricity. Should the borrower submit a loan application including service to irrigation installations in this area covered by applications and agreements, then full consideration should be given to providing loan funds based upon a dependable and continuous pump irrigation load.

It is estimated that pumps in these areas will average approximately 25 horsepower with an average annual consumption of approximately 600 kwh per horsepower.

Estimate of Future Development and Power Requirements

The following are estimates of growth of service to irrigation installations and estimates of power requirements:

Pumpkin Creek

	Present	Two Years	Five Years	Ten Years
No. of Installations	0	20	30	45
Avge. HP/Installation		30	30	30
KWH/HP		600	600	600
Lodgepole Creek				
No. of Installations	30	40	50	60
Avge. HP/Installation		20	20	20
KWH/HP		750	750	750
North Platte Valley				
No. of Installations	0	5	10	20
Avge. HP/Installation		25	25	25
KWH/HP		600	600	600

IRRIGATION SUMMARY
WYRULEC COMPANY
WYOMING 6 GOSHEN

General

This borrower's pump irrigation load and added potential load will consist of the following:

A. Pumpkin Creek - Irrigation will be from wells drilled in Pumpkin Creek Valley located in Nebraska. Irrigation will be by gravity ditches and some farms will use sprinkler irrigation systems.

B. Platte River - This will be by wells drilled in the Platte River Valley in the vicinity of Lingle, Wyoming.

C. Rest of Systems - The remaining irrigation will be the small pumps located on gravity ditches where rights for use of diversion and where allocated waters are being used at higher elevations to bring more productive land above the ditches into cultivation.

Pumpkin Creek Valley

The Pumpkin Creek Valley is about 8 miles wide and starts near the Wyoming-Nebraska line. It runs from there 50 miles east to its confluence with the North Platte River. The main tributaries that enter Pumpkin Creek are from the south where there are springs in the canyons that are cut into the adjacent table land or higher plains. The water from these springs flows on the surface only a few hundred feet and disappears into the alluvial mantle which covers the valley floor. Other numerous small creeks which carry water during periods of heavy rainfall contribute to the underground water supply.

It is in the alluvial formations where the majority of the irrigation wells are located. These wells are fairly close to the creek or valley floor where pumping lifts are most favorable. Other wells have been developed in other type formations but the majority and better wells for irrigation will be those in the alluvial fill.

Crops are primarily wheat, oats, hay and corn. Other crops can be produced. The length of the growing season is 5 months which also represents length of pumping season.

The depth to the water table in Pumpkin Creek, in general, increases with the distance from the creek and in some places is more than 100 feet below the land surface. In the valley or lower areas where most of the irrigation is practiced, the water in most places is less than 25 feet below the land surface. From the wells being used for irrigation the yields range from 200 gallons per minute to 2400 gallons per minute. Average installations are capable of approximately 1,000 gallons per minute. Installations will average approximately 25 horsepower and kilowatt hour consumption will average 700 kwh per horsepower in 1956; 800 kwh per horsepower in 1959; and 900 kwh per horsepower in 1964. Wells in operation during the past have pumped annually approximately 100 acre feet of water.

Based on studies conducted by the Geological Survey, it is estimated that an average of about 21,000 acre feet of ground water leaves the Pumpkin Creek Valley annually. The following is an excerpt from Geological Survey Circular 156 entitled "Reconnaissance of the Geology and Ground-Water Resources of the Pumpkin Creek Area, Morrill and Banner Counties, Nebraska":

> It is estimated that an average of about 21,000 acre-ft of ground water leaves the valley of Pumpkin Creek annually as surface flow. (See Table 1,) This represents the amount of rejected or excess ground water and is approximately the amount of additional ground water available for development. If sufficient ground water is withdrawn to cause a decline of the water table, additional water would be salvaged from loss by evaporation and transpiration and would be available for irrigation use. Also, some of the water pumped for irrigation would percolate into the ground-water

reservoir. Part of this "return flow" could be re-used; however, part of this water should be allowed to leave the area in order to prevent accumulation of salts in the soil and ground water.

Based on existing annual discharges of 100 acre feet per installation, the above estimates indicate that over 210 irrigation installations could be developed throughout the whole of the Pumpkin Creek Valley. Actual measurement of ground water level in wells in operation in the valley since 1934 shows no decline in water table with current development.

Recommendations

From data available and experience of present development of pump irrigation farms in this area, I feel that financing of electrical distribution facilities to provide service to these irrigation installations could be based on a continuous and dependable pump irrigation load.

Serious low voltage condition already exists in the service provided in this area. It is quite urgent that the cooperative correct this condition. Consideration is being given towards the construction of a transmission line into the valley. It is my recommendation that the transmission line be of sufficient capacity to provide service to the irrigation load as reflected in this report.

Platte River Valley

The irrigation load in this area will be located west of Lingle, Wyoming. The majority of the land in cultivation has rights to diversion waters of the Platte River. Farmers have put down wells to secure adequate irrigation water on a portion of the farms where, for their water rights, there are too many acres of land under cultivation. Several installations are being served single-phase by use of phase convertors. Others are interested in converting to electricity but available line capacity has limited development. The cooperative could serve 15 installations immediately if power was available. The number of installations will likely increase to 25 within five years. The underground water aquifer could support additional development but due to limitation of productive land and the existing diversion water rights, development will be limited to approximately 25 installations.

Full consideration can be given to financing three-phase service to these installations based upon a sound continuous irrigation load as indicated in the power requirement estimates.

Rest of System

The rest of the irrigation loads served by the borrower are small pumping units located on ditches and small canals. These waters are a part of the U. S. Bureau of Reclamation development in which waters have been appropriated. Pumps are used by individual farmers to raise water for use on higher and more productive land.

Available water has been fully appropriated. Therefore, any increase in pump units will be limited and will be the result of changing the use of water from one unit of land to another. As indicated in power requirements only a small growth is anticipated.

Service to Irrigation

The borrower is at present providing service to 138 pump irrigation installations. During the 1953 season, 15.9 percent of the energy sold by this borrower was to irrigation and 9.7 percent of their total revenue came from the irrigation consumers.

Estimates of Future Development and Power Requirements

The following are estimates of growth of service to irrigation installations and estimates of power requirements:

	Present	Two Years	Five Years	Ten Years
Pumpkin Creek				
No. Installations	13	35	45	50
Avge. HP/Installation	20	23	25	25
KWH/HP	600	700	800	900
Platte River - Lingle substation				
No. of Installations	9	20	25	25
Avge. HP/Installation	10	15	15	15
KWH/HP	800	800	800	800
Rest of Systems				
No. Installations	116	120	130	140
Avge. HP/Installation	11	11	11	11
KWH/HP	800	600	600	600

IRRIGATION SUMMARY
RURAL ELECTRIC COMPANY
WYOMING 14 LARAMIE

General

Water for irrigation purposes in the area served by this borrower comes from wells drilled in the Lodgepole Creek Valley located in both Wyoming and Nebraska and Crow Creek Area extending into Wyoming and Colorado. Distribution of water from the wells to the land has been primarily by gravity and surface methods. Some sprinkler irrigation systems are in operation and it can be anticipated that additional systems will be put in operation in both areas. The Lodgepole Creek area is the largest, with wells having been drilled and in use from west of Pine Bluffs to an area east of Sidney, Nebraska, in the vicinity of Chappell. The Rural Electric Cooperative out of Pine Bluffs serves the irrigation installations in the valley to within two miles of Sidney, Nebraska; the remaining is served by the Wheat Belt Electric of Sidney.

Lodge Creek

This valley is underlain with stratas of sands and gravel overlaying a strata of silty clay. The source of water is from the sand and gravel formations. Depth to water varies considerably throughout the valley with water within 10 to 15 feet in some areas of the valley floor. Pumping lifts will average approximately 70 feet with pump discharges averaging between 600 and 700 gallons per minute. Difficulty has been experienced in some areas of the valley in getting wells with adequate discharges for irrigation.

History and experience based on existing wells has shown that the water supply has remained very stable. It appears that additional development of irrigation wells on a sound dependable basis is possible in this valley. The limited boundaries of the valley where good farmland is within reasonable pumping lifts and the difficulty in securing good irrigation wells in many areas will limit development and not permit over development. It is felt that conditions are satisfactory to sustain the irrigation development as reflected in this report.

Crow Creek

The irrigation in Crow Creek is small and limited with additional development also limited. The majority of the development of irrigation on the project will be on the Lodgepole Creek area. Once a well is drilled, developed and proven satisfactory for irrigation in the Crow Creek area, it should continue to provide a dependable source of irrigation water. Where the area is primarily a good dry land wheat farming area, most of the consumers in the area are not interested in developing irrigation.

Crops Grown

Field crops being irrigated consist of alfalfa, pasture, small grain and corn for silage. Row or cash crops consist of potatoes, pinto beans, and sugar beets. Considerable diversification of farming is possible in the area which contributes to successful irrigation farming. Good yields are being obtained and pump irrigation has proven economically sound in this borrower's area.

Irrigation Development

At the time of the above visit, the borrower had connected 249 irrigation installations. 232 of these were in operation with 17 installations idle for various reasons. Five new connections had been made during the past year. During the 1953 season 22.2 percent of energy consumed on this system was by irrigation installations and 16.3 percent of their total revenue came from irrigation installations.

Estimates of Future Development and Power Requirements

The following are estimates of growth of service to irrigation installations and estimates of power requirements:

	Present	Two Years	Five Years	Ten Years
Number of Installations	249	270	300	350
Avge. HP/Inst.		20	20	20
Avge. KWH/HP		750	750	750